Adaptto E-drives Lab

MAX-E, MINI-E

Instruction manual

Software version: 1.0 Release

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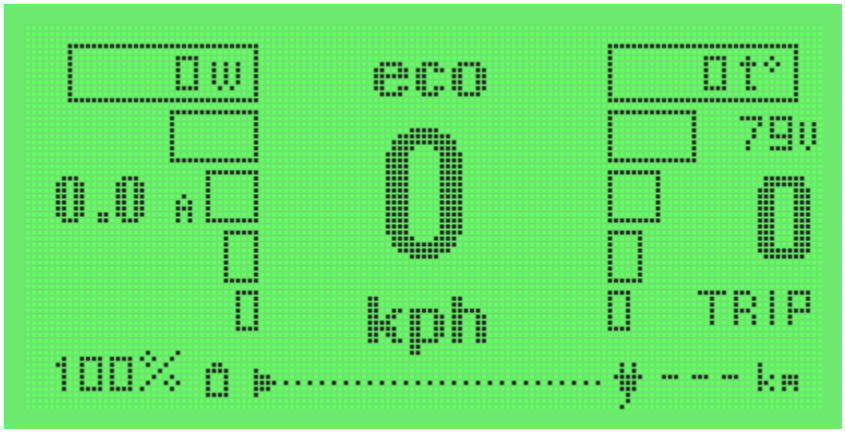
1. Getting started

To make your e-bike go, you need to follow several steps:

Connect controller to your motor, batteries and throttle\e-brake.

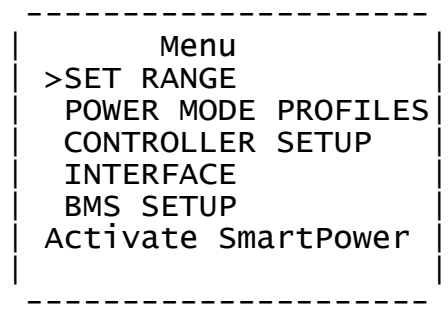
There is no need to match hall\phase wires while connecting controller to the motor because controller has <**Autodetect**> function.

After all connections is done, and the power is connected to the controller you will see the main screen:

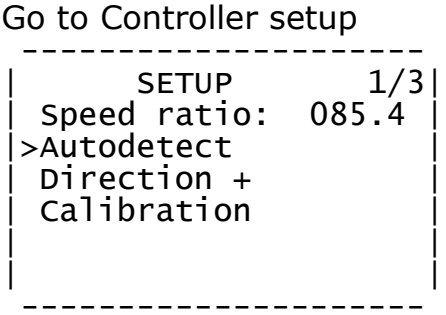


To enter main menu press "**Down**" button. If Quick menu is enabled, press "**Down**" again.

You will see the main menu:



Go to Controller setup



Speed ratio should be set according to your wheel and motor.

The you can measure your wheel and divide the number in mm by number of poles of your motor. Ex for 9C motor in 24 wheel with 2.5 inch tire it will be 1965mm/23=85.4mm

The next step is to <**Autodetect**> hall and phase wires.

Wheel must be **of the ground** at this stage!

Enter the <**Autodetect**> menu by pressing "**Right**" button, then turn the throttle and hold it for a while, wheel will start turning in several seconds. Be careful, it could start turning backwards and will result in turning pedals backward as well. If you see your wheel turns backward, just release the throttle immediately, change the <**Direction**> in the menu and repeat <**Autodetect**>.

The full <**Autodetect**> cycle will take 2-3 minutes, and the wheel will be turning slowly first part of procedure and than at around 75% pwm while the last part. Please note the wheel must be off the ground and freewheeling.

When <**Autodetect**> completes you will see <**RetCode:001**> message at the screen.

After halls and phase configuration is set up and angles are calibrated it is time to set current limits for each profile. This could be done via <**POWER MODE PROFILES**> menu from the main menu:

```
 --------------------
|   Profiles Setup   |
|    |ECO|NORM |BST  |
|Ib A|10 |  25 | 100 |
|Ip A|99 | 120 | 180 |
|IprA|10 |  20 |  75 |
|Skph|25 |  99 | 120 |
|Acc |016| 025 | 032 |
|                    |
 --------------------
```

The first string is Battery current limit for each profile,
Second string is for Phase current
Third string is regen phase current (regen power)
Fourth string is for speed limit
Fifth string is Acceleration rise limit setting (limit your max acceleration)

BMS setup

While MAX-BMS is not connected\disabled you still have to set battery capacity and low voltage discharge cutoff.

You may set up both AH and WH capacity for the current battery you use. This values could be changed automatically while first full discharge cycle.

```
 --------------------
|     BMS SETUP    1/2|
|>BMS enable   NO     |
| BMS SETUP           |
| Battery AH   10.2AH |
| Battery WH   00350Wh|
|                  2/2|
| Dischg cutoff 026V  |
 --------------------
```

Regen setup

Also it is recommended to set correct settings for regen-braking.

When using hall effect sensor you need to set max battery voltage and max regen current. The brake signal could be inverted if requred. When using regular on\off switch it is recommended to enable **<Smooth>** option as well. This will make current ramp up smooth and will lessen the stress on dropouts.

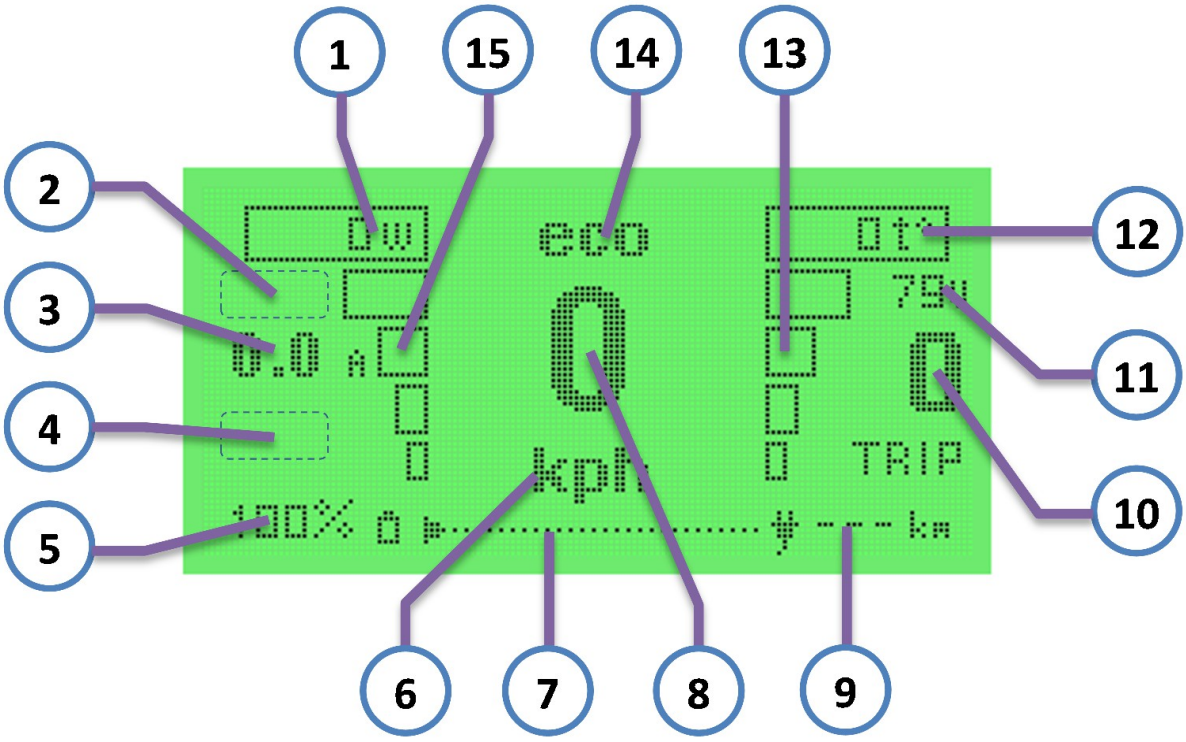
```
 --------------------
|   REGEN SETUP    1/2|
|>Enable         ON   |
| Max Voltage    098 V|
| Rated Current  35.2A|
| Inversion      N    |
|                  2/2|
| Smooth         NO   |
| PWM limit      95.3%|
 --------------------
```

Throttle/E-Brake calibration

Go to Controller setup->Calibration and set **<Thr limits>** (see page 7 for details)
After changing the limits it is recommended to calibrate throttle linearity, especially if you use hall-sensor based throttle. After entering calibration mode, you will have to steadily turn the throttle from min to max within 2-3 seconds 4 times. Cycles longer than 3 seconds or shorter than 2 seconds will be ignored. If the cycle is accepted, you will see the actual graph on the display. After 4th iteration the calibration will be completed and your throttle response will be linear.
If you would like to add progression to throttle response, you may change **<thr progr.>** from 0 to 1-3 depending of your requests.
After setting up the throttle, please go to **<Brk limits>** and calibrate e-brake sensor the same way as the throttle limits.

Now your controller is set up and ready to go!

2. Main screen



The main screen displays the most important information while you drive:

1. Actual power in Watts
2. **TCS** (traction control system) enabled\activated
3. Current in Amps
4. Smart-Range data (when enabled)
5. Battery SOC in %
6. Speed units
7. Battery "fuel" gauge
8. Speedometer
9. Estimated remaining rage at current SOC
10. Current trip distance
11. Battery voltage
12. Motor temperature (when temperature sensor connected and enabled)
13. Temperature\Overheat current limit bar
14. Mode\info messages display (eco\normal\boost\cruise\brake\charge etc.)
15. Power bar

From the main screen you may press <down> to enter menu\quick menu,

<left> and <right> will move you to Health monitor or Stats\Watt-meter screens.

3.Menu and functions

```
 --------------------
|       Menu         |
|> SET RANGE         | 1)
|  POWER MODE PROFILES| 2)
|  CONTROLLER SETUP  | 3)
|  INTERFACE         | 4)
|  BMS SETUP         | 5)
| Activate SmartPower |
|                    |
 --------------------
```

(1) Smart Power menu.

Using this feature you can set the limit of capacity you are planning to spend per known range and the controller will limit your power to allow you reach the destination.

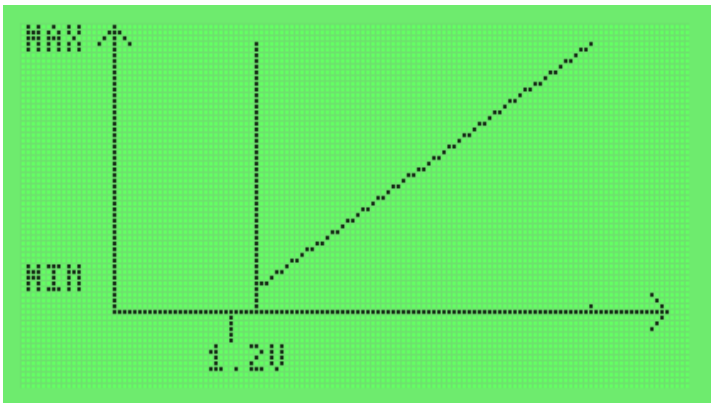
```
 --------------------
|  SmartRange setup  |
|>Range       010.0Km|  The range you are planning to cover
| Power amount 04.0Ah |  Amount of power to spend
| Power range  01.3Ah |  Additional power allowed.
| Go                  |  Start current trip
|                     |
|                     |
|                     |
 --------------------
```

(2) This menu is for setting 3 power profiles according to your needs.

```
 --------------------
|   Profiles Setup   |
|    |ECO|NORM |[BST] |   profile name
|Ib A|10 |  25 | 100  |   battery current limit
|Ip A|99 | 120 | 180  |   phase current limit
|IprA|10 |  20 |  75  |   regen power = regen phase current
|Skph|25 |  99 | 120  |   speed limit
|Acc |16 | 25  | 32   |   acceleration limit
|                     |
 --------------------
```

(3) Main Setup

```
 --------------------
|      SETUP       1/3|
|>Speed ratio:  085.4 |    mm per electric revolution (speedometer calibration)
| Autodetect          |    autoset halls\phase wires combination
| Direction +         |    if your wheel rotates backwards, change the direction
| Calibration         |3.1)
|                  2/3|
| Regen settings      |3.2)
| Charge settings     |3.3)
| Traction settings   |3.4)
| Advanced settings   |3.5)
|                  3/3|
| DCDC setup          |3.6)
| Master passwd       |    master password (appear at  startup when enabled)
| Menu passsword      |    menu password (locks main menu)
| Protection    N     |    Status of hardware overcurrent protection
 --------------------     (press right to reset)
3.1)
 --------------------
|   Calibration    1/3|
|>Voltage adj  078.6v |    Voltmeter calibration
| ShuntR       0.301m |    Internal Shunt value (changing this factory calibrated)
| Shunt2       +0.00% |    Affect profile current setup
| Zero offset  +0     |    Standby 0.0A current setup
|                  2/3|
|>Thr limits          |    Throttle mapping feature
| Thr linear          |    Calibrate throttle linearity
| Thr progr.   1      |    Set throttle progression
| Brk limits          |    E-brake mapping feature (for hall sensor e-brake)
|                  3/3|
| Weight       148Kg  |    Total weight of bike+rider
|>Int TSensor  KTY83  |    Type of internal thermosensor
|                     |
 --------------------
```



The following screen shows throttle\e-brake limits setup.
<left>-<right> buttons will move the limits and <up>-<down> will switch between lower and upper limit.
When you move the throttle\e-brake lever you will see it's the exact position in the bottom of the screen. In calibration mode throttle\e-brake will be disabled and will not control the bike.
Please note that it is highly recommended to leave a gap between the start of throttle/e-brake move and actual limit as shown on the picture above because hall-effect sensors could have some temperature drift resulting in incorrect signals processing and sudden e-bike move\braking.

3.2)

```
 --------------------
|   Regen Setup   1/2|
|>Enable          ON  |
| Max Voltage     100 V|
| Rated Current   35.2A|
| Inversion       N   |
|                   2/2|
| Smooth          NO  |
| PWM limit       95.3%|
|                     |
 --------------------
```

Regen braking enable\disable
Maximum regen voltage
Maximum regen battery current
e-brake signal inversion

Smooth regen when using on\off regen switch
Pwm limit for regen

Maximum regen voltage(should be set to maximum allowable voltage for your battery)
Maximum regen-brake current(set to maximum allowable charge current for your battery)
PWM limit for regen (higher the value will result in lower minimum speed but lower efficiency)
values larger than 95.3% are **NOT** recommended (may lead to motor overheating)

3.3)

```
 --------------------
|   Charge setup  1/2|
|>Charge Enable   ON  |
| Max Voltage     100 V|
| Supply Current 35.2A|
| Charge Current 28.5A|
|                   2/2|
|>Supply Vdrop    1.23V|
| ChgSensor inv   NO  |
|                     |
 --------------------
```

Regen-charging enable\disable
Maximum charge voltage(set to max battery charge voltage)
PSU current limit
Battery charge current limit

Maximum voltage drop of PSU used for regen-charging
Charge sensor inversion(reserved for OEM)

3.4)

```
 --------------------
|   TRACTION SETUP 1/3|
|>Throttle mode   TORQ |
| Thr cruise      OFF  |
| PWM rise lim    00016|
| SPD smooth      08192|
|                   2/3|
|>2WD Enable      OFF  |
| Slave SL:       24kph|
| TRK dV:         0.00#|
| TRK dA:         00000|
|                   3/3|
|>LS Enable       OFF  |
| LSCurrent:      3.51A|
| LSstart         05KPH|
| HSstart         10KPH|
|                      |
 --------------------
```

Select either speed or torque based throttle control
Cruise control feature enable\disable.
PWM rising speed limit (lower the value for smooth startup)
Smoothness of speed limit feature

2WD mode enables the slave controller when connected
Maximum allowable speed for the second controller
Traction control: acceleraton limit 0=disabled
Traction control: anti-skid feature

Low Speed slow start feature
Battery current limit for speed lower <**LSstart**>
<LSstart> and <HSstart> is the speed range for the current to rise between <LSCurrent> and rated battery current for choosed profile.

3.5)

```
 --------------------
|   Advanced setup 1/5|
|>Angle corr.   -4.99°|   Static Angle correction (halls position in current motor)
| Timing        +034uS|   Static time correction (firmware version related)
| Ind timing    0628uS|   Set for minimum power consumption at 75% PWM no load
| PWR timing    +0.53 |   Set for maximum torque at high power levels
|                  2/5|
|>OVS timing    007°  |    0-7 value allows you to run a bit faster on the same voltage
|>Termosensor   YES   |    Motor T° sensor Disable\Enable\Enable with prediction.
| TSensor type  KTY84 |    Motor T° sensor type
| T° limit      180°C |    Motor T° limit
|                  3/5|
|>Hall Offset   300°  |     Hall Angle offset
| Hall Reverse  NO    |     Hall reverse
| Wire Reverse  YES   |     Phase wires revers
| Wire R, mOhm  100   |     Phase wires resistance
|                  4/5|
| ControlMethod SLESS |     Sin-wave(AUTO)\Square-wave\Sensorless square-wave
| SIN5X         0000  |     5 Harmonic compensation
| SIN7X         0000  |     7 Harmonic compensation
| SIN11X        0000  |     11 Harmonic compensation
|                  5/5|
|>System Reset        |     Full system reset to factory defaults
|                     |
 --------------------
```

3.6)

```
 --------------------
|     DCDC setup   1/1|
|>Current limit  9.62A|    Set Current limit (will hiccup when overcurrent detected)
| Voltage out    6.29V|    Output voltage
| DCDC Enable    NO   |    Enable\Disable DCDC mode
|                     |
 --------------------
```

DCDC mode is a special feature that allows you to use your controller as a power supply with given voltage. You can set voltage and current limit you want to get, than enable DCDC mode.
It is required to use charging inductor and capacitors at the output.

(4) Interface Setup

```
 --------------------
|  Interface SETUP 1/2|
|>Speed Units    KPH  |    Speed ununts (toggles between metric and imperial)
| t° display     OVH  |    t° bar on main screen show t° or overheat current limit
| LCD refresh    0.2S |    LCD refresh speed
| Brightness     HI   |    LCD Brightness HI/LOW
|                  2/2|
| BackLight      off  |    Enables back-light (only when dc-dc connected)
| HeadLight      str  |    Enables headlight (only when dc-dc connected)
| Quick menu     NO   |    Enables\disables Quick menu
| Buttons map         |4.1)
|                     |
 --------------------
```

4.1) Quick menu buttons setup

```
 --------------------
|  Buttons Mapping 1/2|
|     Quick menu:     |
|> Button UP    TRK   |
|  Button Left  Light |
|  Button Right Cruise|
|                     |
|   Traction Control  |
|                     |
| Throttle buttons 2/2|
|> Button A     Charge|
|  Button B     Light |
|  Button C     Cruise|
|  Button D     Horn  |
|                     |
|Charge enable\disable|
|                     |
 --------------------
```

Charge	Regen-Charging mode enable\disable
Cruise	Throttle Cruise enable\disable
Backwd	Reverse on\off
TSC	Traction control
LCD Br	Display brightness LOW\HIGH
2WD	2nd controller enable\disable
LS en	LS mode enable\disable
DCDC	DCDC mode on\off
Horn	Horn ON
Light	Low Beam Light on\off
HiBeam	Hi Beam Light on\off
Strobe	Strobe mode ON
StrHrn	Strobe with Horn ON

(5) BMS Setup

```
 --------------------
|     BMS SETUP    1/2|
|>BMS enable   NO     |
|>BMS SETUP           |5.1)
| Battery AH   10.2AH |
| Battery WH   00350Wh|
|                  2/2|
| Dischg cutoff 026V  |
|                     |
 --------------------
```

Max-BMS enable\disable
Only when using MAX-BMS
Battery capacity AH
Battery capacity WH

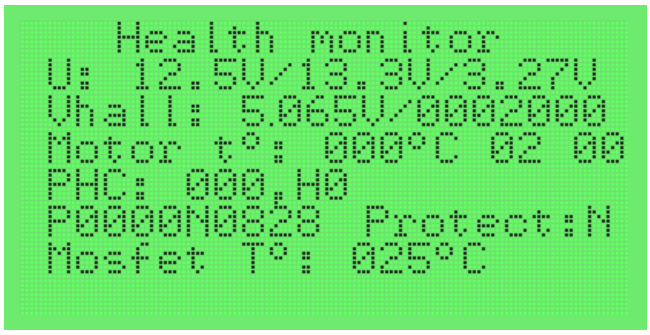
Low Voltage Discharge cutoff

4.Info and error messages

!THR!	show when more than 4.5v appear at the throttle input.
!BMS!	show when bms enabled but not connected\misconfigured
LowBat	means your battery voltage is lower than set in BMS section
!HALLS!	means hall sensors are not connected\not workable
Cruise	shows when cruise control is active
brake	will show up while regen-braking.
Charge	will show up when regen-charging mode enabled (by pressing “up” while charging you will go to Charge monitor)
Protect	means than over-current protection is on.

5.Health Monitor

There are several parameters that could be useful for controller setup and diagnostics.



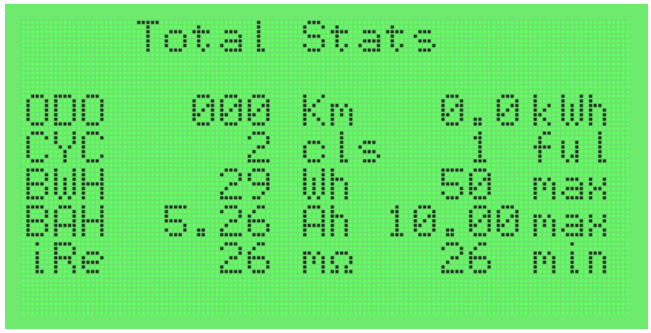
First string: important controller voltages.
Second string: motor hall sensor voltage.
Third string: motor temperature.
Forth string: hall sensors positions.
Fifth string: service information and protection.
Last string: internal controller temperature.

6. Stats\Watt-meter

The following screen shows trip and battery statistics:

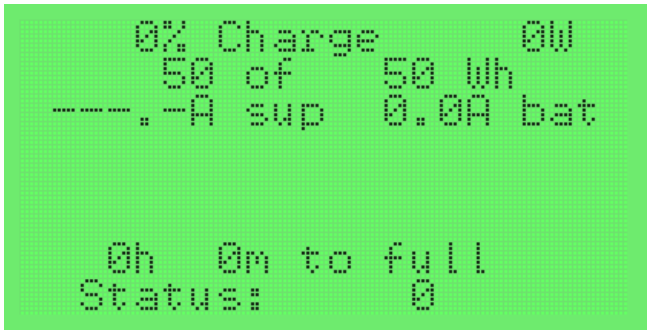
Upper left corner: current SOC (state of charge)
Current trip fom last reset : Used power in WH
Moving time from last reset : Used power in AH
Remaining range : Remaining WH
Average moving speed : Avg consumption
Maximum recorded speed : Max consumption
Regen capacity AH : Regen WH
Average battery voltage : Battery iRe

To reset current trip\or set Full Charge after charging please press <up> button.
From the stats\watt-meter screen you can also go <down> to Total Statistics:



Odometer : Total KWH used
Number of cycles : Full battery cycles
Current battery WH : Maximum recorded WH
Current battery AH : Maximum recorded AH
Current battery iRe : Minimum recorded iRe

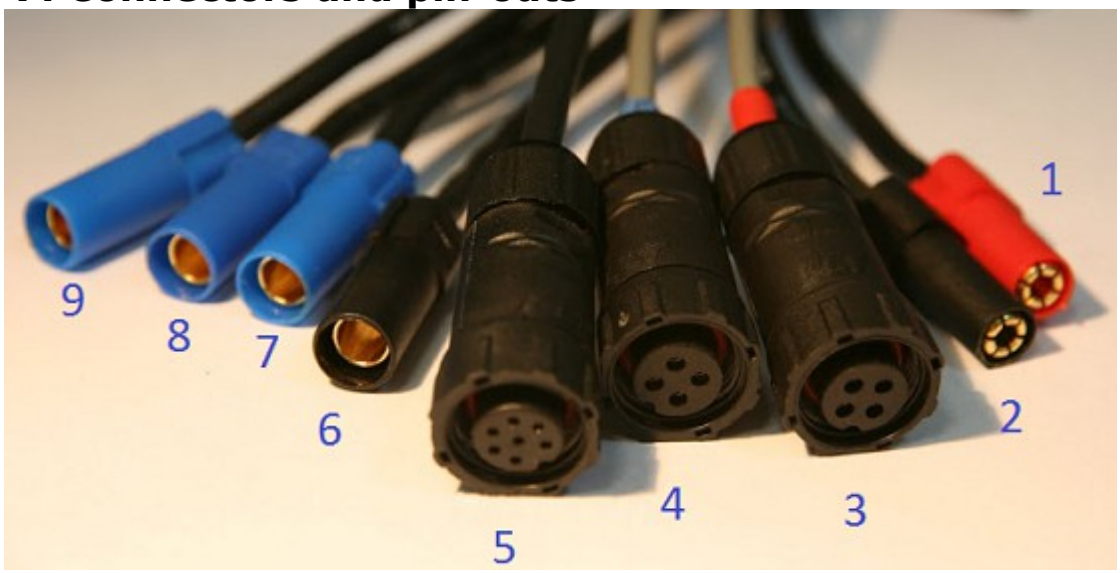
From Total Statistics screen you can go <down> to Charge screen (also appear when you press <up> button from the main screen in Charge mode):



Current SOC counted in WH : Charge power W
How much WH is remaining to : full charge WH
Power supply Current : Battery charge current

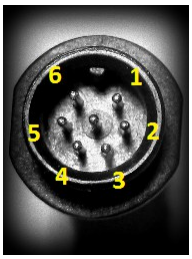
How much time is remaining to Full charge.

7. Connectors and pin-outs



1) Positive power lead (red housing male)
2) Negative power lead (black housing male)
3) BMS connector (red heat shrink)
4) Display connector (blue heat shrink)
5) Hall\motor connector
6) Negative charge lead (black housing female)
7) motor phase 1 (blue housing female)
8) motor phase 2 (blue housing female)
9) motor phase 3 (blue housing female)

Hall\motor connector pin-out (male motor side):



1) hall 1
2) hall 2
3) hall 3
4) motor temperature sensor
5) GND
6) +5v

Throttle\E-brake connector pin-out:

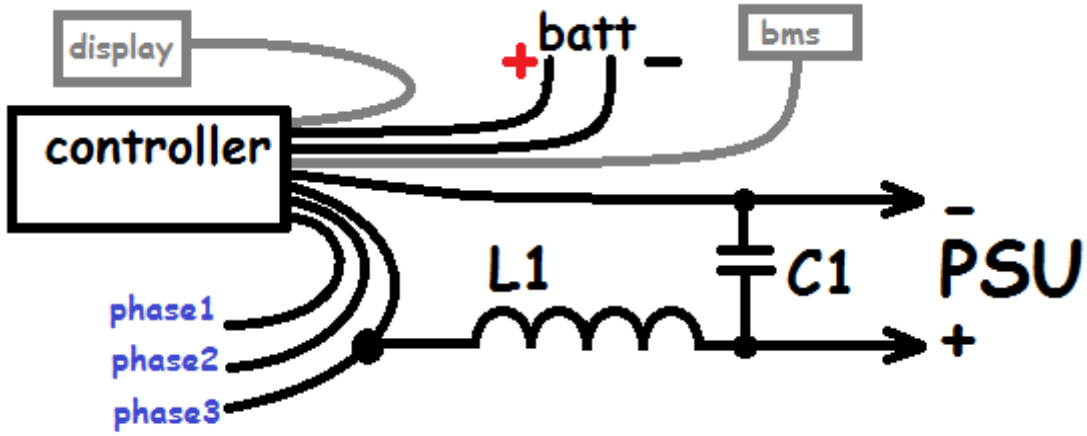
1) +5v (brown wire)
2) Brake hall out (white wire)
3) GND (black wire)
4) Throttle hall out (blue wire)

USB female connector

Uses regular pin-out with shorted data+ and data- for most phones compatibility.

8.Charging and DCDC mode connection

To charge your battery via regen-charging mode you must connect PSU (Power Supply Unit) to the controller via Inductor according to the following picture.



Inductor L1 must be 15-30uH with sufficient current rating (>than PSU max current)
Capacitor C1 must be 470-1000uF with voltage greater than PSU voltage
Left side of L1 connected to ANY of 3 phase wires, while they still must be connected to the motor. Negative lead of the PSU must be connected to Negative Charging lead of the controller (black female XT150 connector)

In charge mode when Charge is enabled and PSU connected, charging will start automatically. For setting Charge parameters please see page 8 <Charge setup> menu.

In DC-DC mode load must be connected instead of PSU, but L1 and C1 is mandatory.

10.Serial number and hardware related data

Serial Number _____

Shunt Resistance _____

Initial firmware version _____

Notes _____

_____

_____

_____

_____

_____